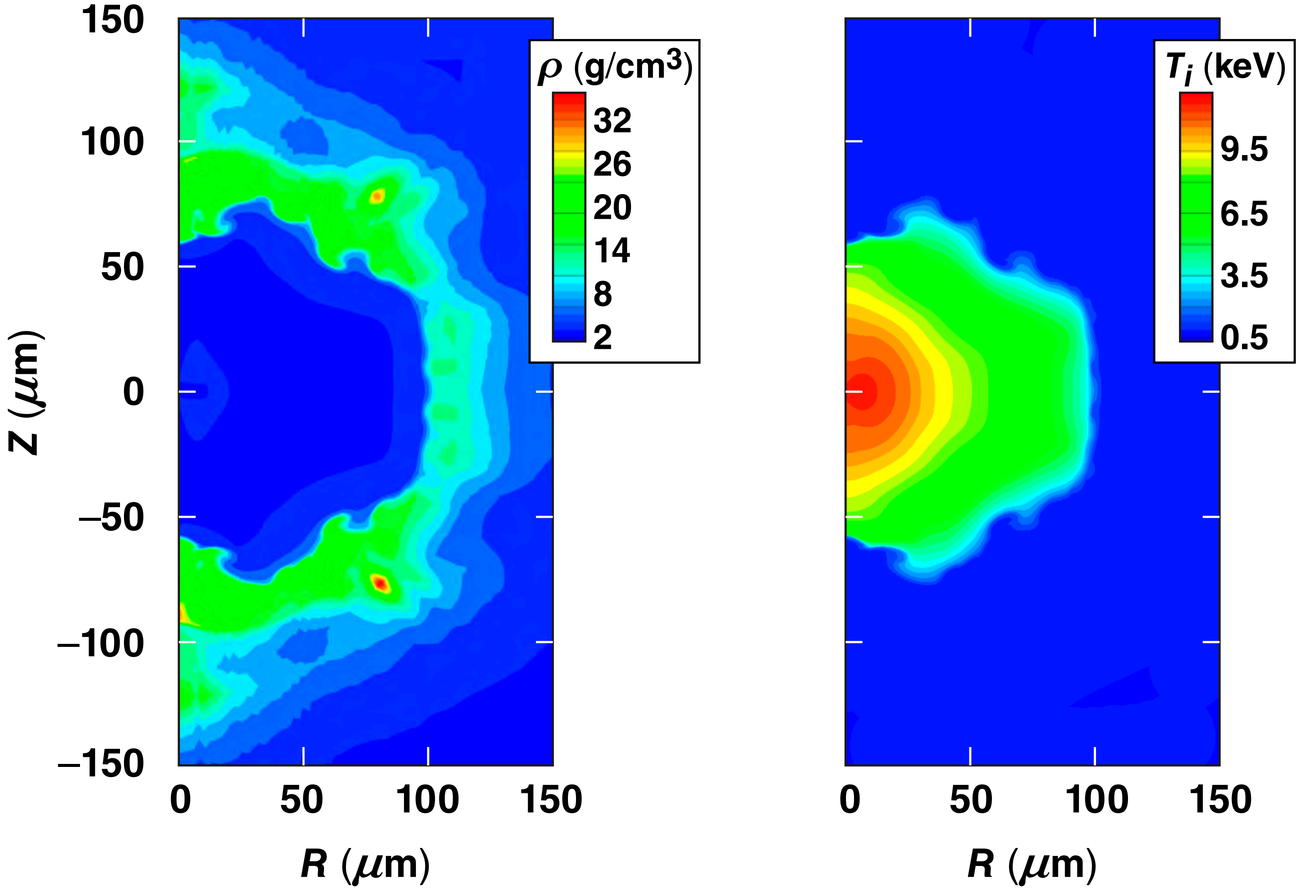
Optimization of Neutron Yields on the NIF from Room-Temperature DT Targets



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Summary

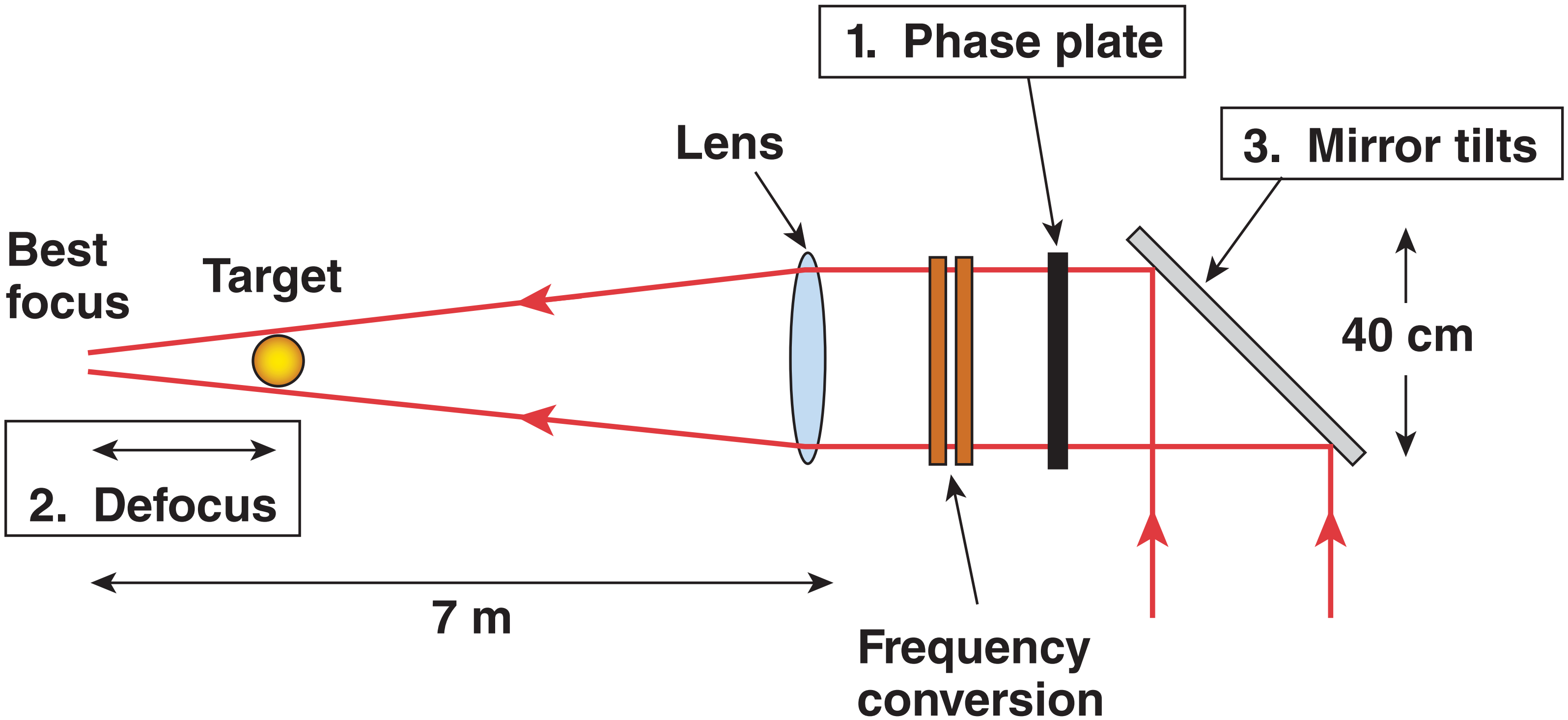
Progress is being made toward designing high-neutron-yield polar-drive targets for the NIF

- Primary motivation is neutron diagnostic development
  - also test polar drive on the NIF
- Uniform drive is possible using existing NIF hardware
  - defocus the beams
  - repoint the beams
  - spread the beams within a quad
- The optimum target employs an SiO_2 shell with a CH ablator
- Yields around 10^{16} are expected for 1 MJ

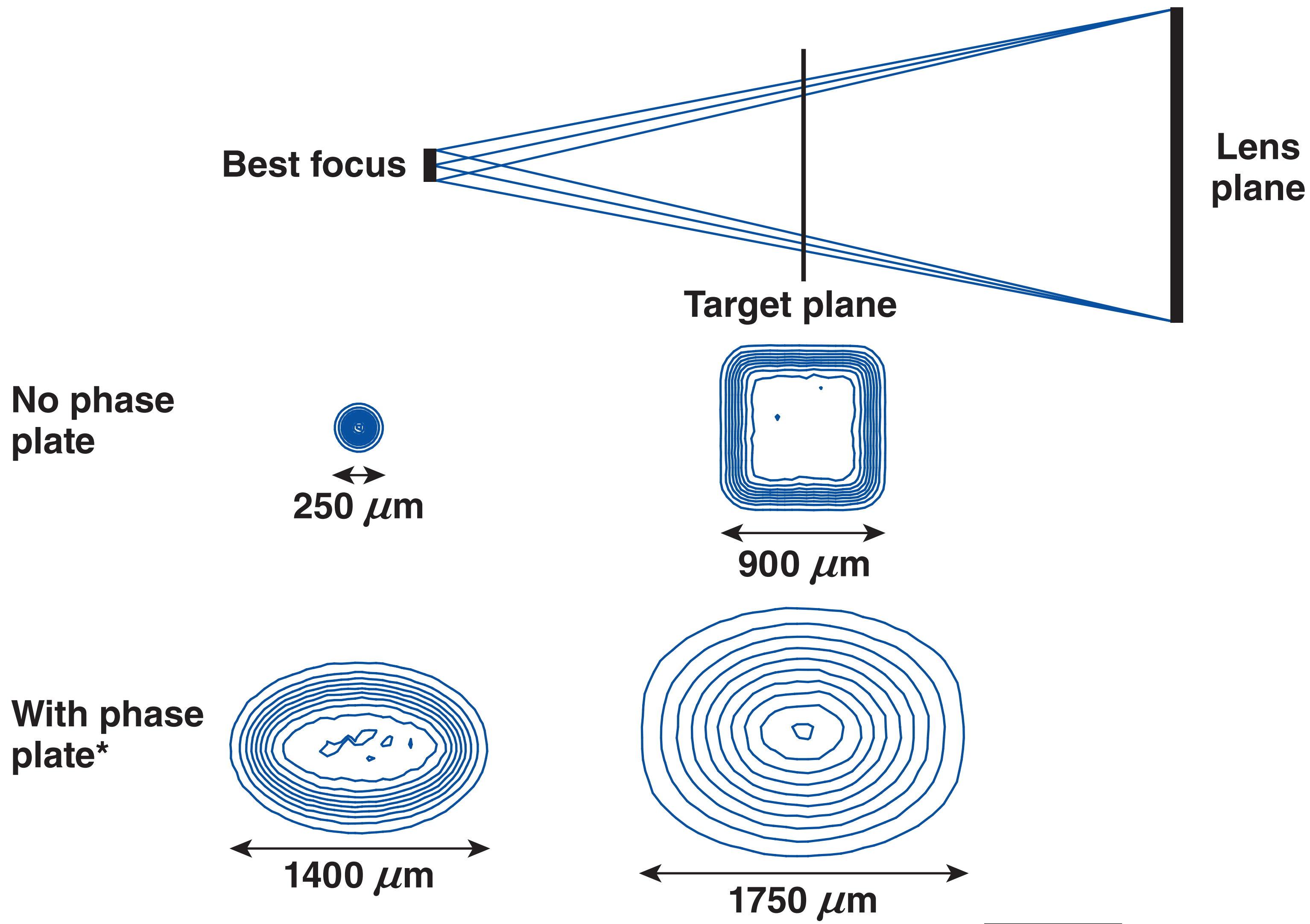
Three hydrodynamic codes are being used iteratively

- *SAGE* is used to identify uniform irradiation conditions
- *LILAC* is used to optimize the 1-D design
  - from 350 kJ to 1.5 MJ
- *DRACO* is used for full 2-D simulations
  - initially focus on 350 kJ

The polar-drive designs use only readily available capabilities on the NIF



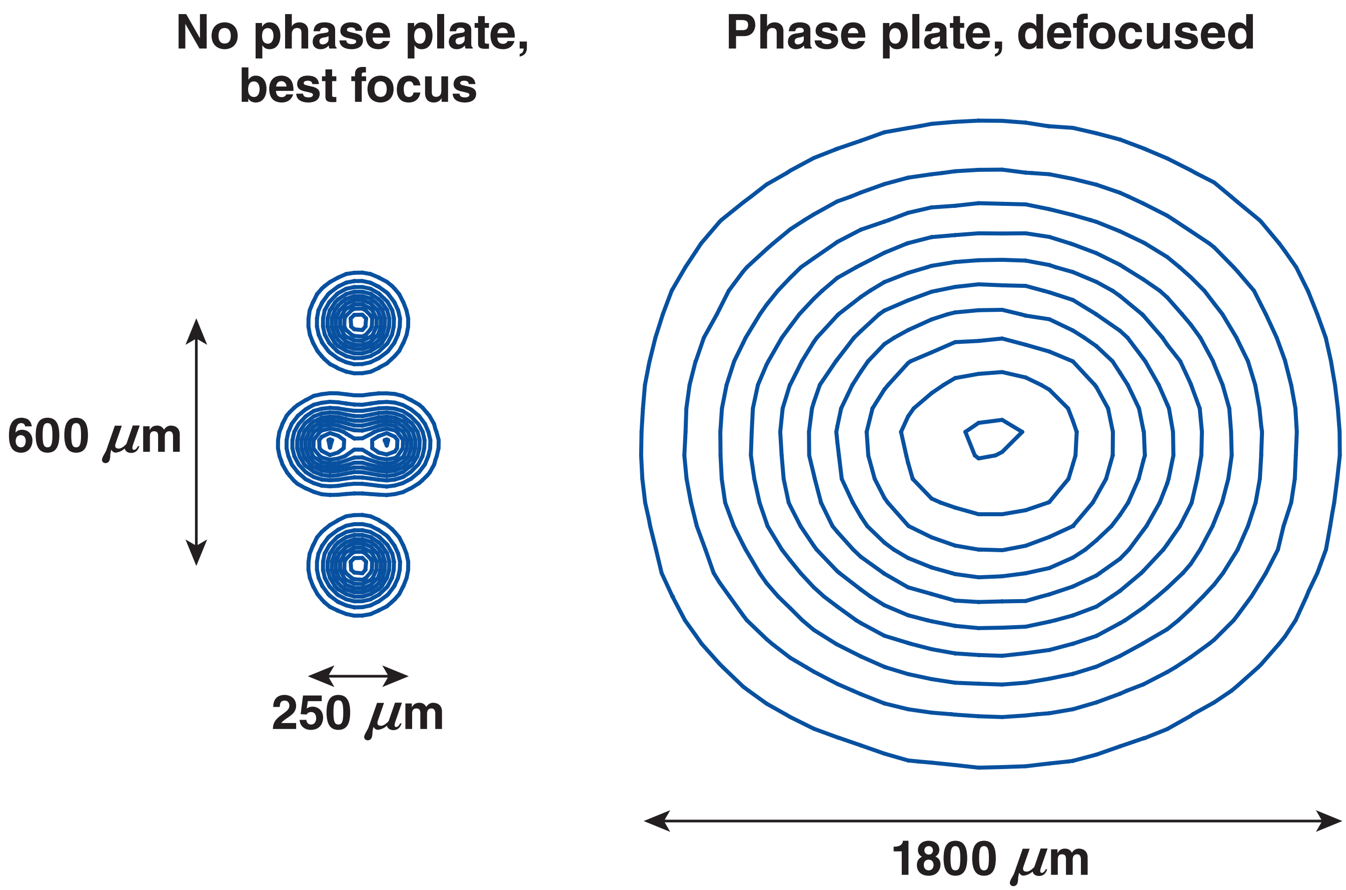
Target-plane distributions out of best focus are calculated using a simple geometrical-optics model



TC7884

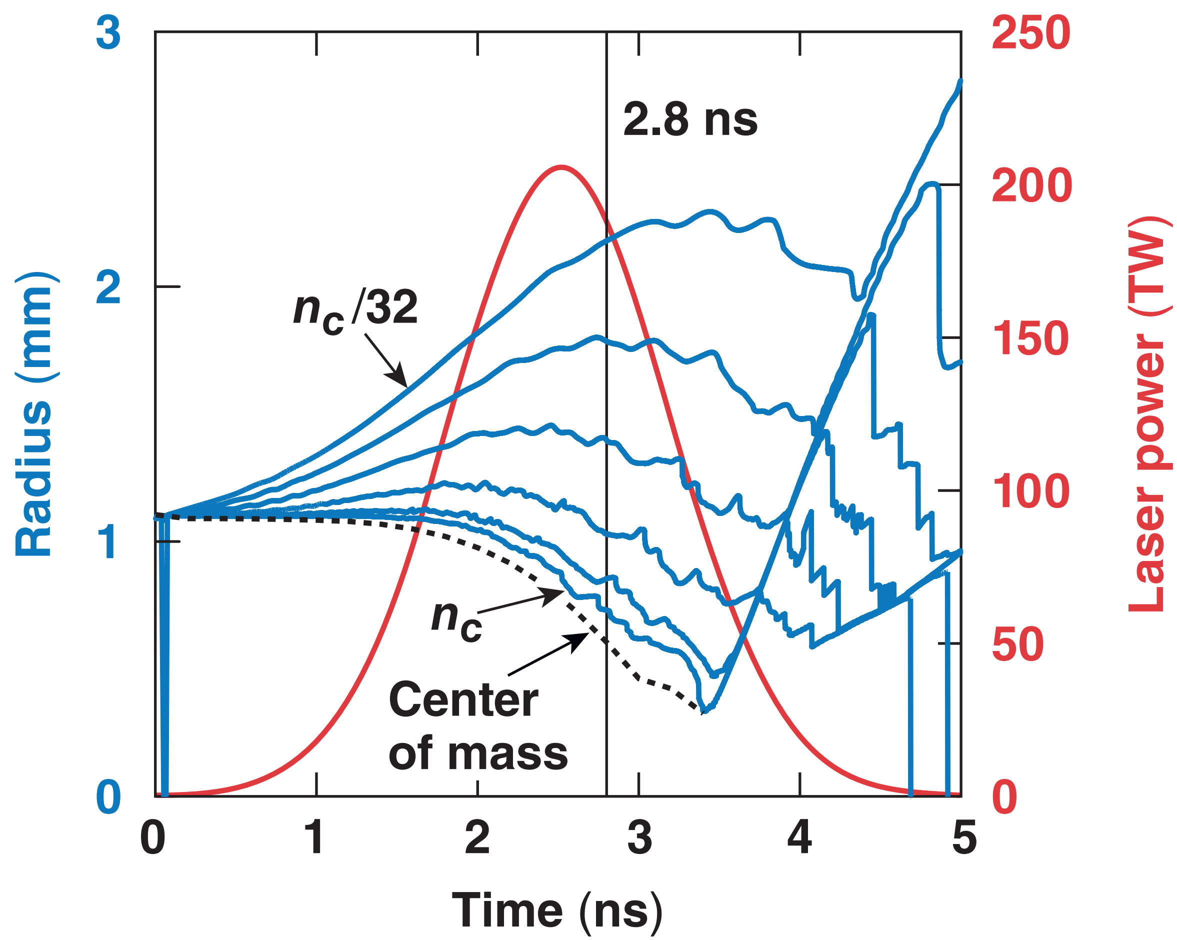
*D. Munro parameterization

Target-plane profiles with greater spatial broadening can be obtained using split-quad focusing*



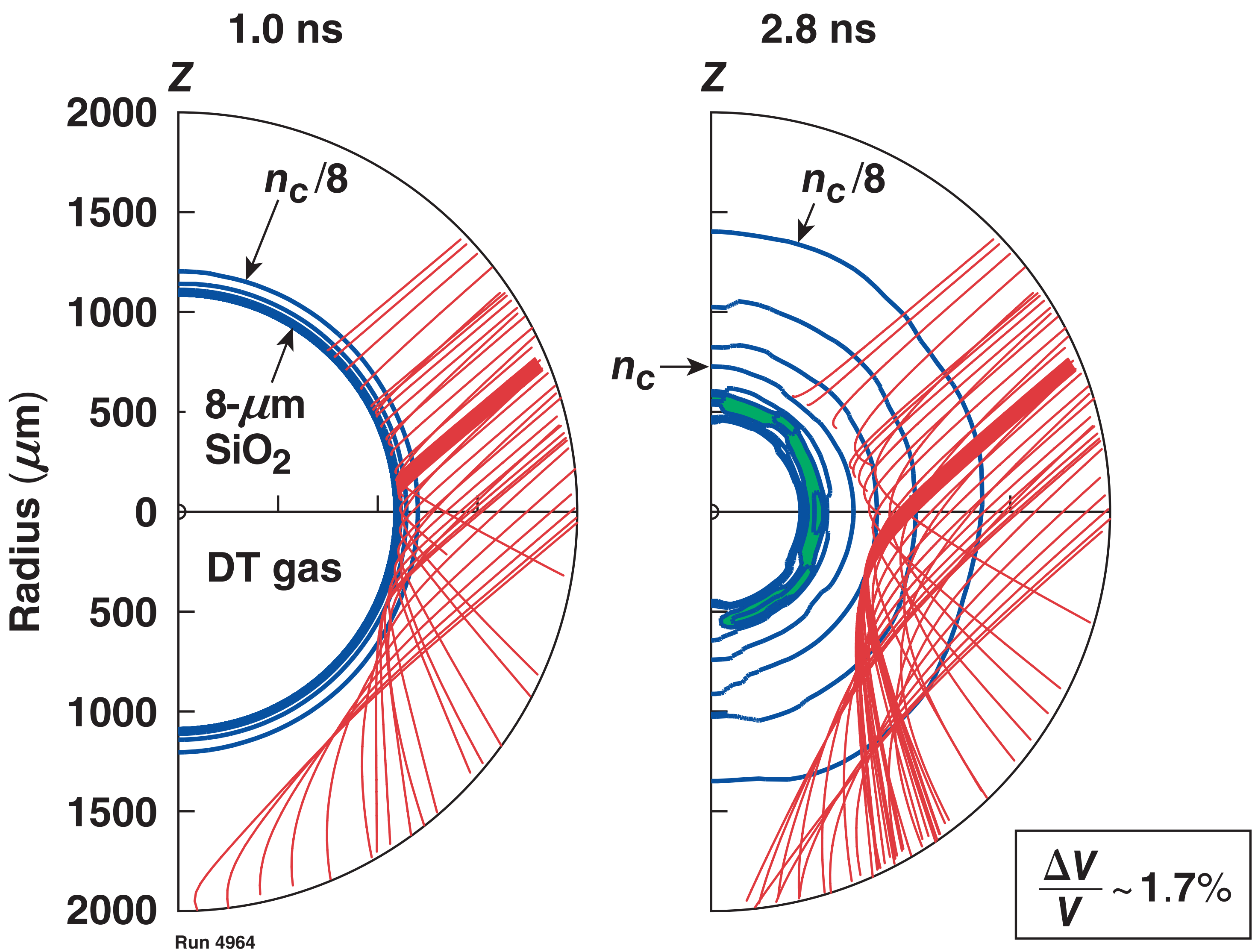
*Suggested by E. Moses

The 350-kJ design is diagnosed at 2.8 ns, just before peak neutron production



E15384

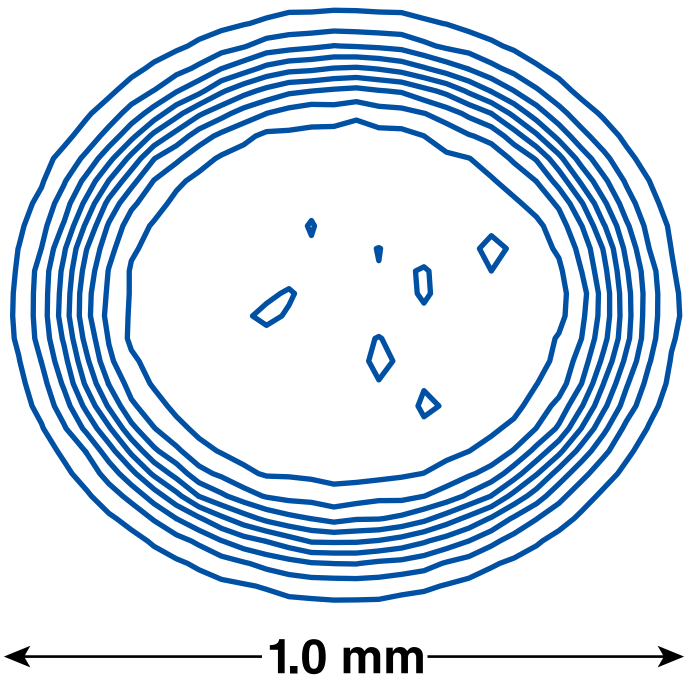
At 2.8 ns the shell is imploding with a high degree of uniformity



TC7885

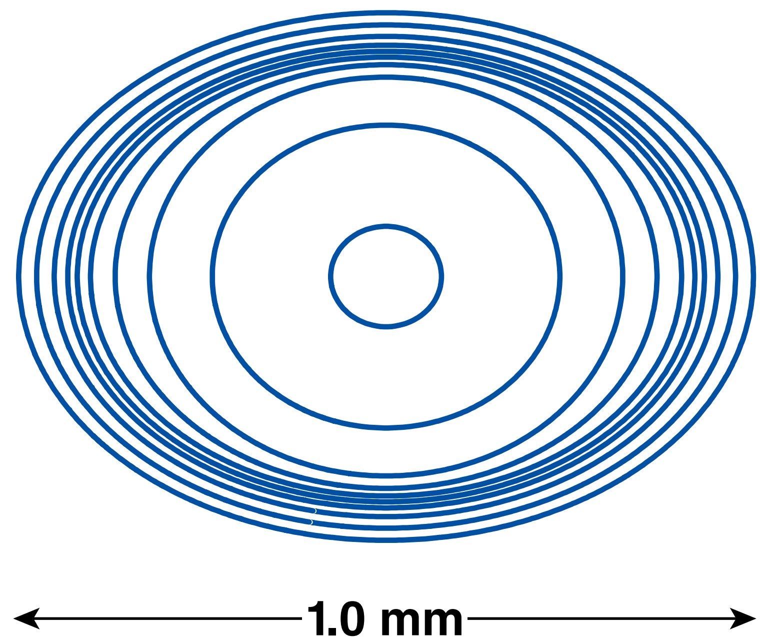
The original and Rev. 1 inner-cone designs are significantly different

Original
(a, b) = (739, 636) μm



D. Munro "Scoping model"

Rev. 1
(a, b) = (824, 590) μm

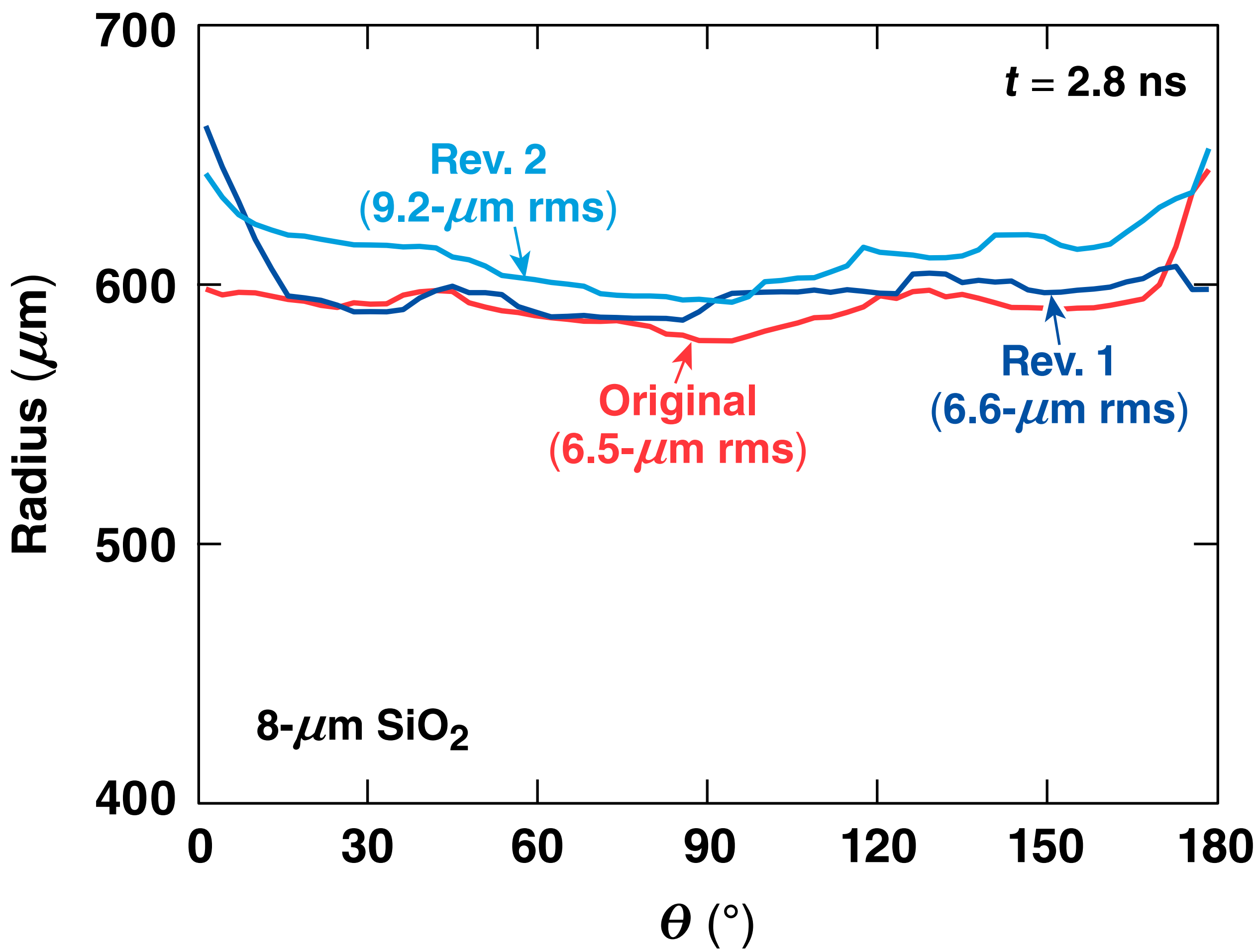


D. Munro "Ellipse model"

Sub 41, Sub 42

TC8157

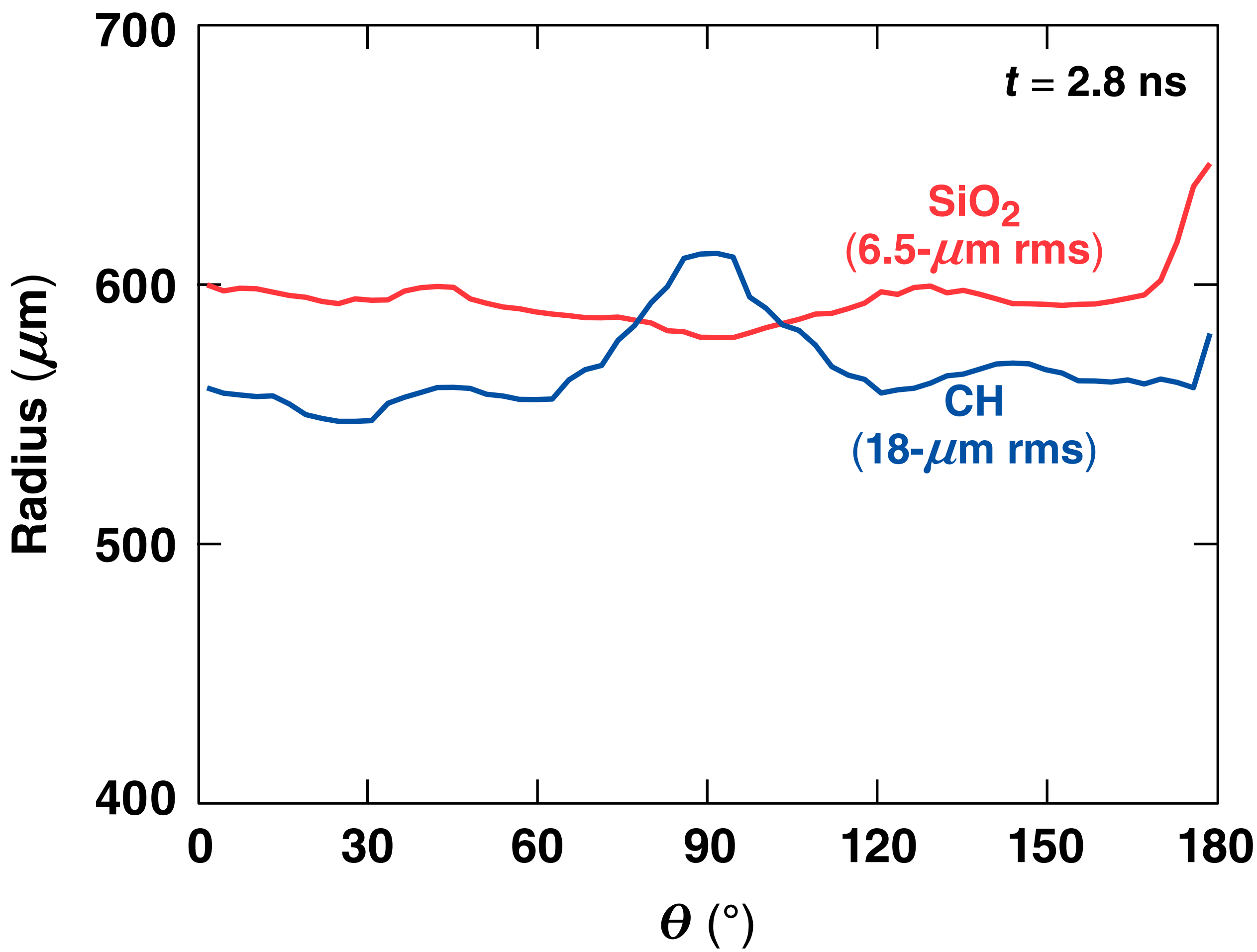
Substituting the Rev. 1 or Rev. 2 phase plates in the original design makes little difference to uniformity



Runs 4964,5030,5031

TC8158

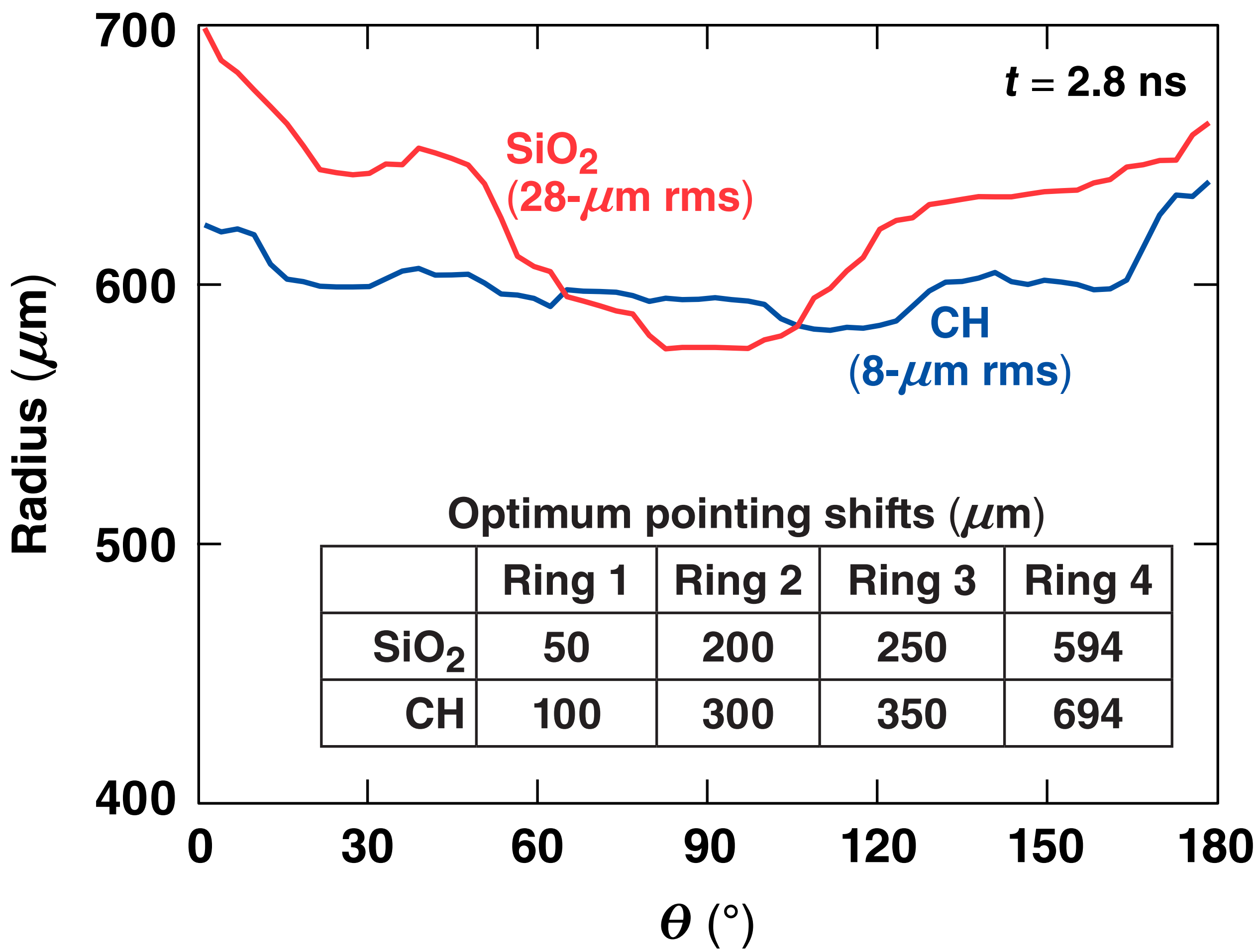
With the beam pointings optimized for SiO_2, a CH target with equivalent mass is underdriven at the equator



Runs 4964,5157

TC8159

The beam pointings can be adjusted to be optimum for CH



Optimum pointing shifts (μm)

	Ring 1	Ring 2	Ring 3	Ring 4
SiO_2	50	200	250	594
CH	100	300	350	694

Runs 5110,5152

TC8160

The highest 1-D yields are obtained from SiO_2 targets with CH ablators

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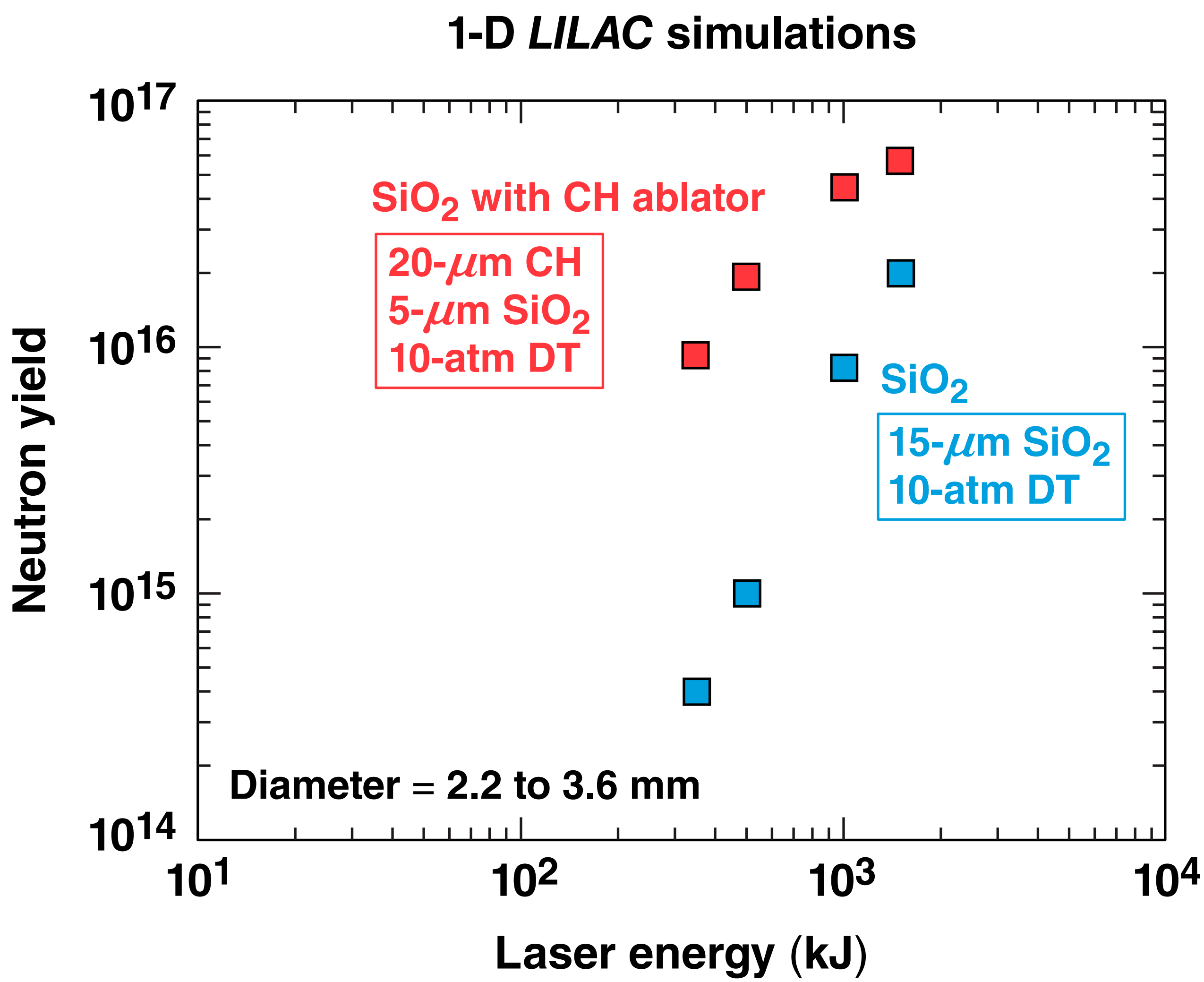
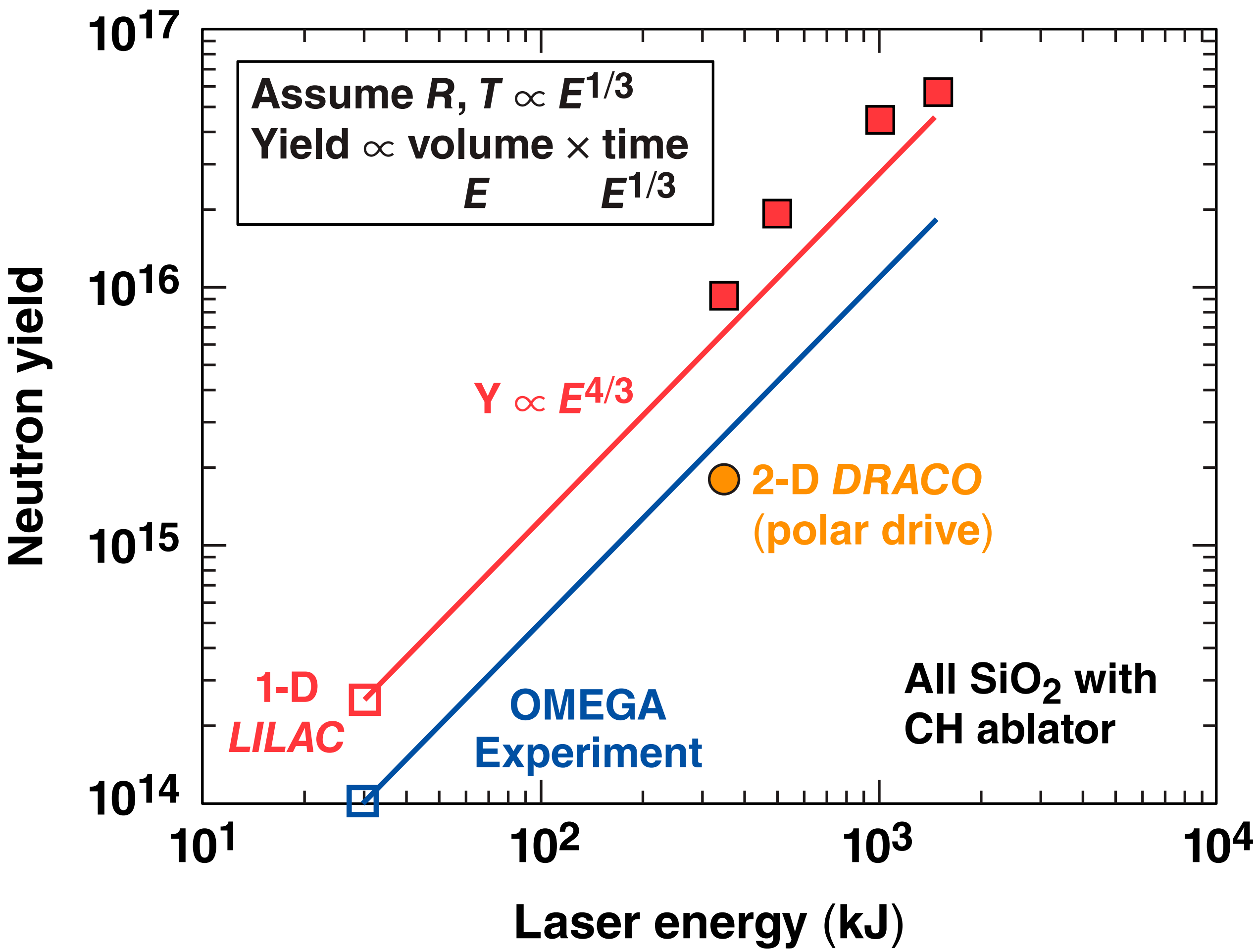


TC8161

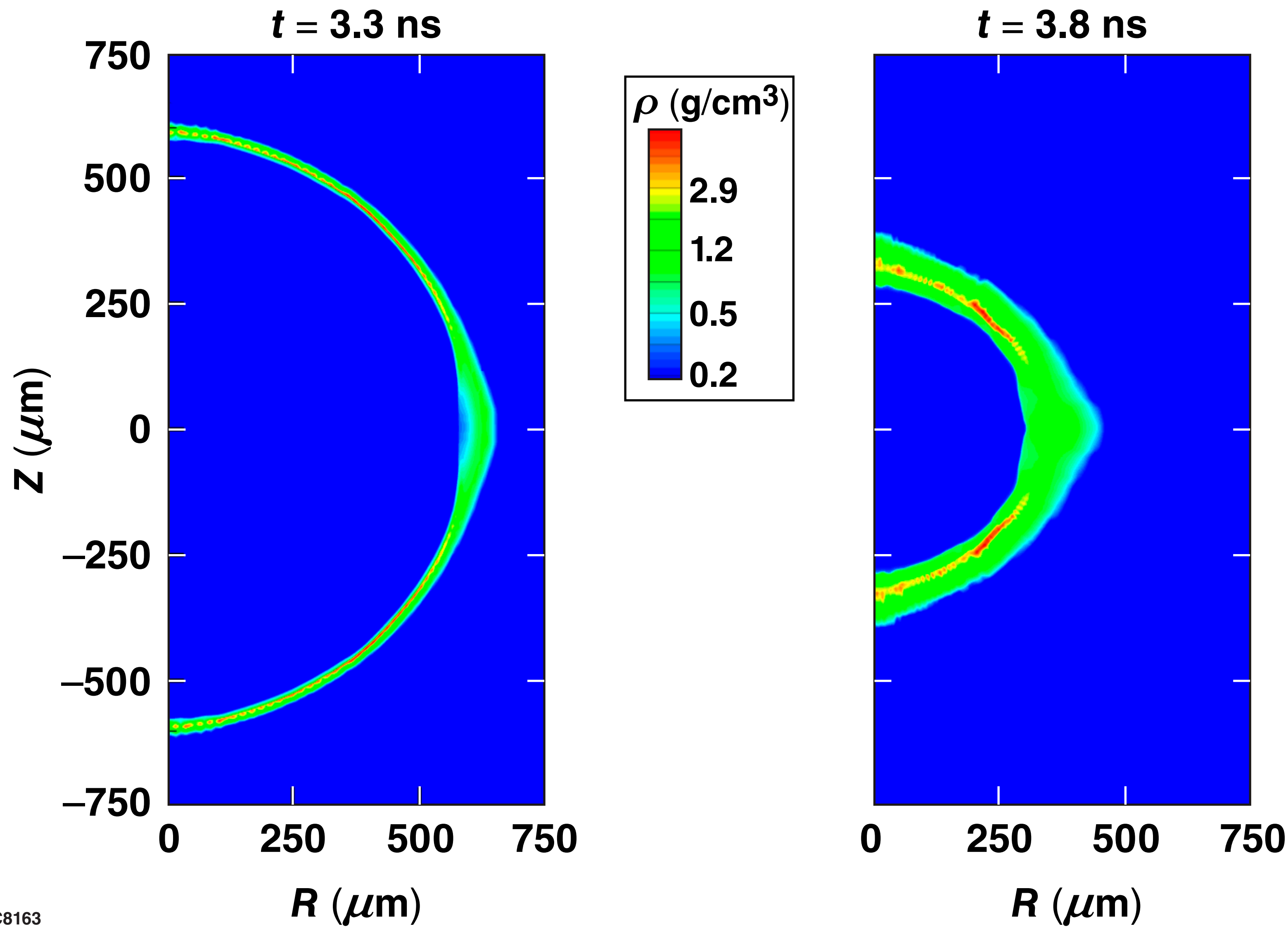
The anticipated yields are consistent with OMEGA results and a very simple scaling model



TC8162

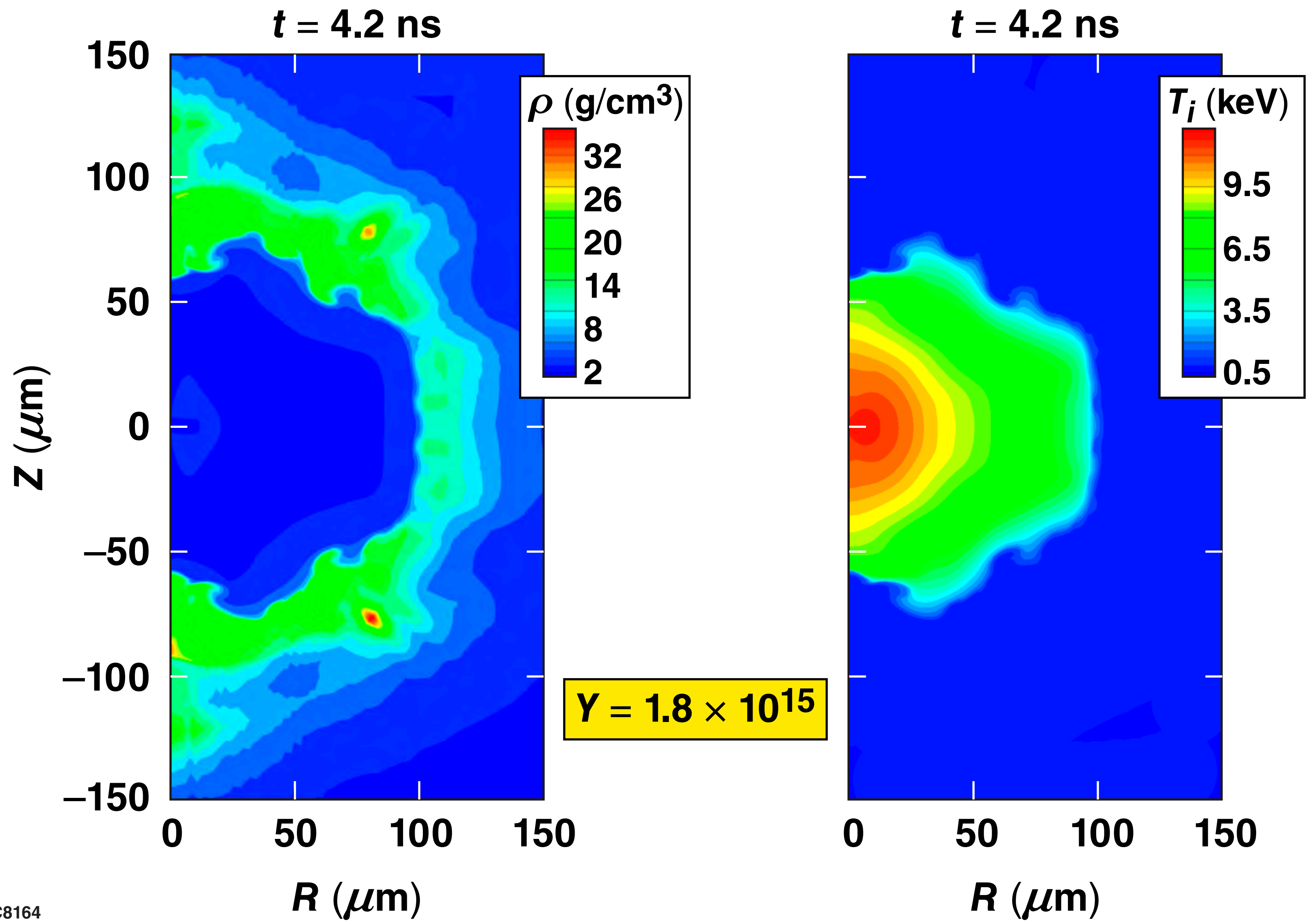
The 2-D *DRACO* simulation shows a fairly uniform implosion but with a weaker drive at the equator

UR LLE



TC8163

At peak neutron production the shell is nonuniform but there is a region of ~10-keV ion temperature



$Y = 1.8 \times 10^{15}$

TC8164

Summary/Conclusions

Progress is being made toward designing high-neutron-yield polar-drive targets for the NIF

UR LLE

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- The optimum target employs an SiO_2 shell with a CH ablator
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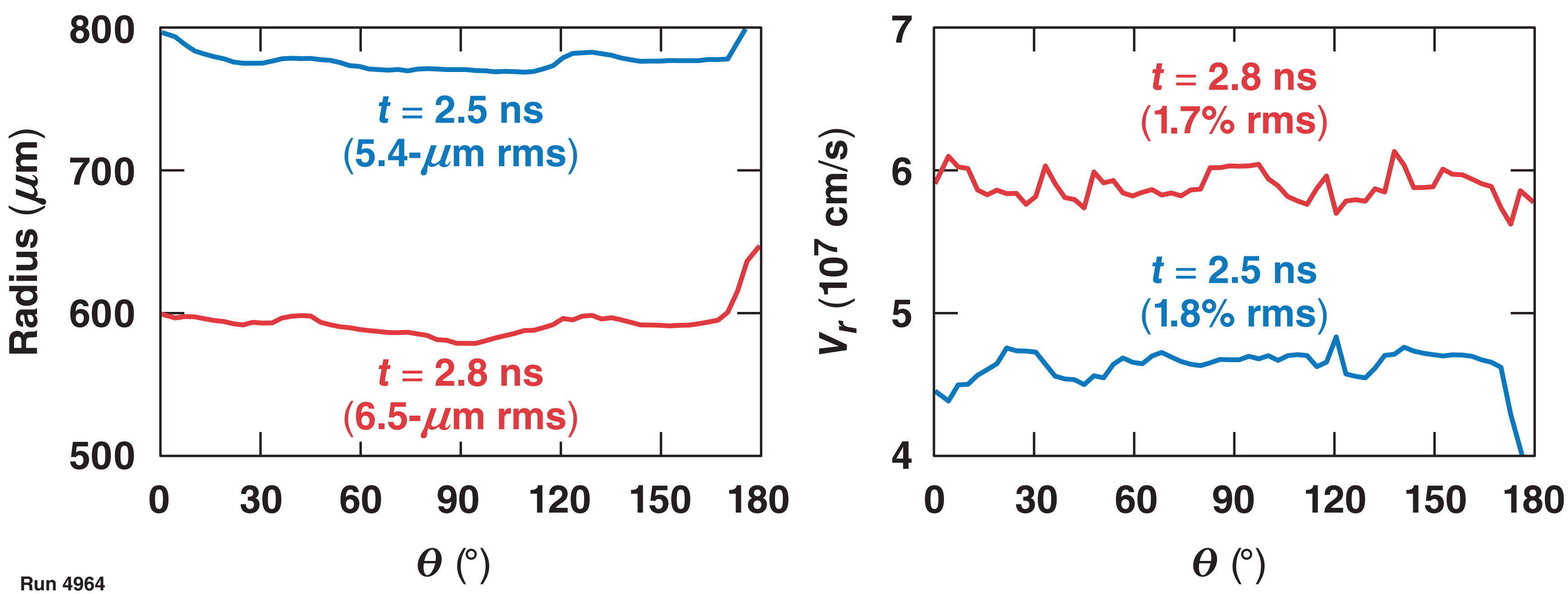
The chances of finding improved designs are good.

TC8155

At 2.8 ns the center-of-mass radius is 600±6.5 μm and its velocity is 6×10^7 cm/s ±1.7%



TC7886

The final NIF phase-plate design is uncertain

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Outer cone

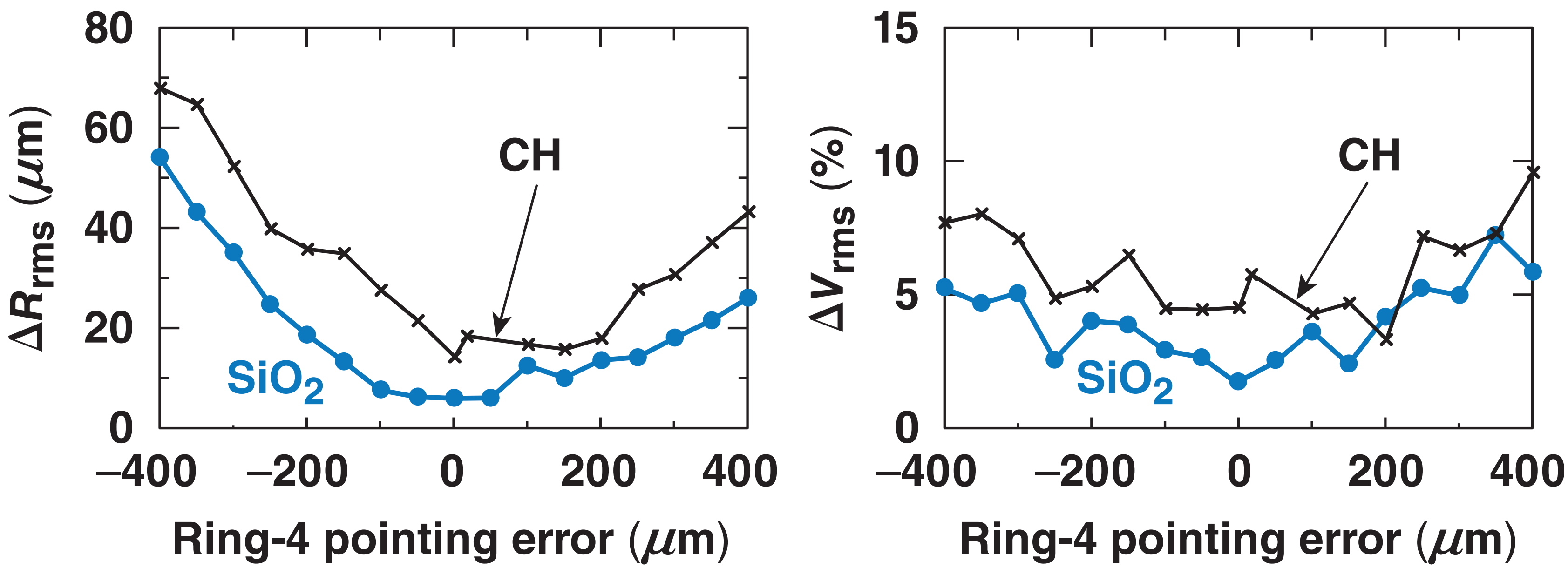
Profile #	(a, b) μm	
1	(593, 343)	Original*
5	(593, 343)	Rev. 1 (300 eV)*
7	(697, 403)	Rev. 2 (285 eV)

Inner cone

Profile #	(a, b) μm	
3	(739, 636)	Original
6	(824, 590)	Rev. 1 (300 eV)
8	(968, 693)	Rev. 2 (285 eV)

*Under fabrication

The optimum pointing for SiO_2 appears to be not quite optimum for CH



- Re-optimization for the actual target design is required.

TC7887a